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No. XIII.

On the Use of the Thermometer in Navigation. By
WILLIAM STRICKLAND.

SIR,

York, April 1798.

Read May 16, 1800. **A** SHORT time before I failed from England in 1794, the third volume of the Transactions of the American Philosophical Society fell in my way. Being at that time attentive to maritime affairs, I could not but be much struck with your maritime observations, and on shewing them to a nautical friend, he recommended me to pursue the same course of observations. This advice I followed; and being well satisfied in having made the experiments in my outward bound voyage, I pursued the same course in my homeward bound voyage; and am about to report the result of both to you, though the last appears likely to be of no farther use than confirming what has already been said on the subject by yourself.

The observations at large I do not send you, being too prolix, the thermometer having been recurred to, much more frequently than here stated; I have noted here only the *changes* which occurred in the temperature of the water, and thereby the table is considerably abbreviated.

In the outward bound voyage the subject appearing most worthy of attention is the probability of a branch striking off from the gulf-stream in a northerly or north-easterly direction, flowing to the east of and somewhat parallel to the banks of Newfoundland. This we appear to have struck on the 18th of Aug. P. M. and continued in it till the 23d A. M. except that on the 20th we crossed a cold current probably here running in upon
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the other from the north-west. That this is a branch of the gulf-stream is rendered probable by the appearance of great quantities of gulf-weed on the 18th A. M. and the circumstance of the flying-fish appearing on the 19th which probably had followed the warm stream into an higher latitude than I can, after looking into many voyages, find them to have been previously noticed. It will appear also from the homeward bound track, that on the 18th of Aug. A. M. we struck a warm current and continued in it several days, which from the longitude could be no other than the current before noticed in 1794, as after quitting the gulf-stream, we had been for several days in the seas cooled by the proximity of the banks of Newfoundland. I have dwelt longer than at first sight may appear necessary on this current, because, though it has been supposed to exist to the south-east of the banks of Newfoundland, it has not been traced so far north as the latitude of the supposed Jacquet-Isle, that is to lat. 47, long. 39. It is probably continued in about a north-east direction, and extends entirely across the Atlantic, till it ultimately strikes the coasts of Ireland and the Hebrides, after having lost in its long course in those northern latitudes much of its heat and at last being reduced to the temperature of the seas, through which it flows. That such a current really exists through the whole of this extent is rendered highly probable from various productions of the tropical regions being frequently thrown on those shores, hitherto supposed to be the accidental effects of storms and not of the unvarying course of nature. The first notice of such substances being cast on those Islands will be found in Vol. III. p. 540, of the Abridgement of the Philosophical Transactions, which abridgement was published in 1749; but the papers abridged many years before.* We here find the facts

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stated

* Phil. Transf. Vol. X. p. 396. and Vol. XIX. p. 298.

stated but not attempted to be accounted for, except that in consequence of some of these having obtained the name of Molucca beans, they are supposed to have found a way out of the North-Pacific ocean, through the north-west passage, then supposed to exist. From that time little if any notice was taken of these exotic productions, till Mr. Pennant made his tour in the Hebrides in 1772, when he mentions his receiving presents of them.*

That the existence of such a current never occurred to the inquisitive and penetrating mind of Mr. Pennant is a sufficient proof, that at the time no knowledge was had of it, he is content with supposing these things to be drifted upon the coasts by storms, and the prevailing westerly winds; but you probably will hold with me that they constitute a strong presumption, if not indubitable proof, of the existence of a regular current; that the course of that current has been hitherto unnoticed; but that could it be ascertained, much advantage would accrue to navigation, by facilitating the voyages from America, through the North-Atlantic, as well as preventing vessels returning by that track from stemming that current, as the Fair-American probably did in her course, almost the whole of the way to Newfoundland; by such knowledge voyages both ways might be materially shortened, as they now are by the like knowledge of the course of the gulf-stream in its easterly and south-easterly progress towards the coasts of Europe and Africa. The current in the North-Atlantic might be detected through the greatest part of the space which it runs by the attentive use of the thermometer, until it has approximated the usual temperature of the sea in the northern latitudes; it might be thus probably ascertained to the fiftieth or fifty-fifth degree of north latitude, as the course of the gulf-

* Tour to the Hebrides in 1772. Chester, printed in 1774, p. 232.

gulf-stream has already been determined for an equal or greater distance by the same means. It is therefore very desirable that a vessel should be employed to cross the Atlantic in an easterly and westerly direction in various latitudes, between latitude 47 and 60, when the direct course of this current might be detected, and the torpitude of each side of it fixed as far as could be done by the thermometer. Having run into great length on the *probability* of a current, it is now necessary to return to facts more immediately connected with our subject, the accuracy of the thermometer in ascertaining our situation at sea.

On the 22d of August late in the evening the water fell in temperature four degrees to 64; on the next day at noon having fallen to 62 and suspecting that we might be in soundings, though no alteration had taken place in the colour of the water, I induced the captain to sound, but no bottom was found at 140 fathom; on the 24th it will appear by the chart to have fallen to 58, and on the 25th to 56, about which time we were undoubtedly on Jaquet, or False bank, and on the 26th having fallen to 51 at 8 A. M. and assumed a green cast. I was desirous of sounding again, but in consequence of the ill success attending our former attempt, and not yet placing any reliance on the thermometer, the captain was unwilling to lose time in sounding, supposing that we were only approaching Jaquet or False bank, but the next day having spoke a banker, he informed us that we were on the grand bank, and that Cape Race bore W. N. W. 150 miles. Upon sounding at noon we struck the ground at 37 fathoms. Here let me remark, that our reckoning as shewn on the chart has been well kept, and that the thermometer has with great precision indicated our situation; on the 21st at noon in a supposed branch of the gulf stream 72°.—22d, approaching Jaquet bank and at

no great distance from it, 68° .—23d, still nearer 62° .—24th, on the edge of the bank 58° .—25th, on Jaquet bank 56° .—26th, on the grand bank 52° .—thus at this season of the year is there a difference of 20 degrees of the thermometer between the water on the bank, and in the same latitude in the ocean, not far to the east of it.

Our captain a sensible and observing man, as well as very experienced mariner, struck with the regular gradation of the thermometer on the approach of the bank, and convinced of its having pointed it out long before he had suspected his arrival upon it, from this time paid much attention to the thermometer. He found as I had foretold that it would equally shew by the rise when we had quitted the bank, and observed that as it would still more accurately define the limits of the gulf-stream, as it was hotter than any other part of the ocean, he might with great advantage make his passage to New-York by following the northern eddy of the stream. This eddy he knew to exist, but was unacquainted with the limits of it, and knew not how to ascertain them, except by the thermometer. We pursued this eddy pretty accurately having made good the latitude of New-York in long. 69. in about nine days from quitting the banks, and every day performed nearly equal and good days works. In this course from Newfoundland the thermometer indicated every where the approach to danger; on the 5th of September, the vicinity of Sable Island banks caused a fall of 7° ; and on the 7th, a bank not marked on any chart I have seen caused a fall of 11° degrees. Upon sounding on this bank the ground was struck in 55 fathom, fine white sand, with some specks of red and black. Captain Allyn was so much pleased with the accuracy of the thermometer and with the security in which he had sailed for some time in consequence of it, and so clearly perceived the advantage to

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be derived from it in many instances, that he declared he would never more go to sea without one.

The track of the Fair-American appears to have laid very near to Jaquet island, which in governor Pownall's chart is marked as very doubtful; a good look out for it was kept for several days, but with no effect; this may so far tend to confirm the suspicion of its non-existence.

The journal from America to England, does little more than confirm the previous observations made in this track; the thermometer fell no less than 20 degrees on passing to the south-east of Newfoundland, and rose again 9 degrees in the same longitudes where in our outward bound voyage, we supposed ourselves to be crossing a branch of the gulf-stream. The fall from hence of the thermometer, as the coast of Europe is approached is very remarkable and uniform.

WILLIAM STRICKLAND.

To JONA. WILLIAMS, *Esq.*
Philadelphia.

Thermometrical

Dates. 1794.	Hour of the Day.	Place at Noon.		Temperature of		Appearance of Water.	NOTES AND OBSERVATIONS.
		Lat. N.	Long. W.	Air.	Water.		
July 19,	12	River Humber.		70°	68°	muddy clear dark green do. bright blue	July 19th. Sailed early this morning from Hull roads. At 4 P. M. Spurn lighthouse E. S. E. 5 miles. 20th Spurn lighthouse E. by S. 3 miles. 29th at 8 A. M. St. Kilda E. N. E. 4 leagues. Temperature of the water 56°. The water of the river Humber on the 19th was 68° the weather having for some time been very hot; on entering the sea it was 61° our course was chiefly in sight of land till our departure from St. Kilda this day, and the water frequently varied between 61° and 56° influenced probably by the rivers and varying depth of the coast; about noon the water changed to a bright blue, OCEAN WATER. 30th at 6 A. M. water 57° acquiring warmth as we recede from land; in the evening 58°.
20,	4 P. M.			67	64		
27,	8 A. M.			54	56		
30,	4 P. M.			56	56		
31,	8 A. M.	{ Clofe in with the Butt of Lewes,	11° 15'	56	57		
	4 P. M.			60	58		
	8 A. M.			61	57		
	4 P. M.			57	58		
Aug. 1,	8 A. M.	55	2	63	57		
2,	4 P. M.	55	15	58	58		
	8 A. M.	52	38	66	58		
11,	4 P. M.	52	18	66	61		
	8 A. M.	49	1	65	61		
15,	4 P. M.	48	30	63	62		
	8 A. M.	48	6	64	64		
16,	4 P. M.	47	33	60	66		
	8 A. M.	47	41	66	66		
	4 P. M.		35		51		

Dates. 1794.	Hour of the Day.	Place at Noon.		Temperature of		Appearance of Water.	NOTES AND OBSERVATIONS.
		Lat. N.	Long. W.	Air.	Water.		
Aug. 17,	8 A. M.	47° 44'	36° 16'	64°	64°		ture of the Atlantic at this season of the year above latitude 50°. This day the water gains three degrees of heat. 15th. This morning it has gained four degrees, in the evening fix. 16th. The temperature is 66° and on the 18th 68°. Most of this day much weed floated in the sea, which first led us to suppose ourselves in a branch of the gulf stream, though the thermometer appears to have indicated it since the morning of the 16th by a rise of several degrees; this day at noon according to our reckoning were precisely where Jaquet Ille ought to have been; it is marked as very doubtful in Pownal's Chart of the Atlantic and as we kept a constant look out for it during two days it probably does not exist. 20th. Most of this day the water was found to vary between 64° and 62°. During six hours A. M. and as many P. M. the wind was strong from the N. W. attended with heavy squalls and rain which might have driven before it a current from a colder region, or the thermometer in the air being as low as 62° the air might have had some effect upon it, because on the
18,	4 P. M.			65	64		
	8 A. M.	46° 47'	38° 35'	68	67		
	12				68		
	4 P. M.			70	68		
19,	8 A. M.			69	68		
	4 P. M.	46° 18'	39° 41'	69	67		
20,	8 A. M.	45° 45'	41° 20'	62	64		
	4 P. M.	45° 45'	41° 20'	62	62		
21,	6 A. M.			60	70	bright blue	
	12	45° 18'	43° 22'		72		greenish
	4 P. M.			70	72		
22,	8 A. M.	45° 28'	45° 44'	69	69		
	12				68		
	4 P. M.			72	65		
	10 P. M.			62	64		
23,	8 A. M.			62	62		
	4 P. M.	45° 28'	45° 41'	65	62		
24,	8 A. M.			59	58		
	4 P. M.	45° 41'	46° 2'	61	58		
25,	8 A. M.			60	57		
	4 P. M.	45° 15'	46° 39'	64	56		
26,	8 A. M.			57	51		
	12	45° 37'	48° 27'	60	52		
	4 P. M.				52		21ft

Dates. 1794.	Hour of the Day.	Place at Noon.		Temperature of Air. Water.		Appearance of Water.	NOTES AND OBSERVATIONS.
		Lat. N.	Long. W.				
Aug. 26, 27, 28, 29, 30,	10 P. M.			52°			21st the wind being N. by E. and E. and the thermometer in the air at 60°, the water was at 70° and 72° which indicated our being again in the gulf stream; vast bodies of gulf weed floated in the sea all this day; several shoals of flying-fish also made their appearance at different times of the day, which probably had followed the warm current of the stream, into higher latitudes than they are usually met with. 23d. The water began to cool the last evening and this day being at 62°, supposing we might be on Jaquet bank, sounded but no bottom at 140 fathom.
	8 A. M.			60°			
	4 P. M.	45° 41'	48° 40'	64	57		
	8 A. M.			60	58		
	4 P. M.	45 12	48 57	63	58	green	
	8 A. M.			63	62		
	4 P. M.	44 11	49 30	65	64		
	8 A. M.	43 32	50 52	62	65		
Sept. 1, 2, 3, 4, 5, 6,	12 P. M.			63	66		26th. This day the water was at 51°, and much changed in colour, and we were probably on the eastern edge of the great Bank having crof- fed Jaquet bank yesterday, when sounding might have been met with; but having failed in finding them on the 23d, our captain not yet confiding in the thermometer, did not choofe to lose time in trying for them again. 27th. Sounded this day at noon and found a bot- tom at 37 fathom, when to the surprize of the captain we were undoubtedly on the great Bank. Spoke at 6 P. M. a Banker who informed us that
	4 P. M.	42 59	51 48	64	70	bright blue	
	8 A. M.			66	69		
	4 P. M.	42 30	53 35	63	68		
	8 A. M.	42 16	55 21	69	70		
	4 P. M.	42 8	57 22	68	71		
	8 A. M.	42 8	57 22	70	73		
	4 P. M.	42 8	57 22	75	73		
	8 A. M.	42 31	58 55	74	73		greenish
	4 P. M.			73	70		
	9 P. M.			68	68		
	8 A. M.			70	66		
	4 P. M.	42 50	61 6	66	66		
	8 A. M.			64	68		
	4 P. M.	42 7	62 38		69		
	12						

Dates. 1794.	Hour of the Day.	Place at Noon.		Temperature of		Appearance of Water.	NOTES AND OBSERVATIONS.
		Lat. N.	Long. W.	Air.	Water.		
Sept. 6,	4 P. M.			64°	72°	bright blue	that Cape Race bore N. N. W. ——— miles, which agrees remarkably with our reckoning. 31 ft. Yesterday in the afternoon the water began to acquire warmth, being at 66°, and this morning being at 70° and of a bright blue indicated that we had quitted the banks.
7,	8 A. M.			70	71	bright blue	
	12			69	69	greenish	
	4 P. M.	41° 42'	63° 58'	69	68		
8,	10 P. M.				64		September 2d. Short and deep swells rolling all this day before a light breeze from W. N. W. we suppoſe ourſelves in the northern eddy of the gulf-ſream, as ſuch a ſwell could not be cauſed by ſuch a breeze unleſs they ran in an oppoſite direction: this was confirmed as the evening advanced, for the breeze getting northward and then to N. N. E. the ſwell entirely abated—while the ſwell laſted the ſhip made only 2½ knots an hour, when it had ſubſided 4 knots. The temperature of the water is now 71, nearly the ſame as on the 21ſt of laſt month, when we ſuppoſed ourſelves in the gulf ſream.
	8 A. M.	44 1	65 52	64	62	muddled green	
	12			63	61	bright blue	
	4 P. M.			62	70		
9,	8 A. M.			69	75		The water having cooled ſeveral degrees and being at 66°, and having acquired a greeniſh caſt we were undoubtedly in foundings but none were attempted; probably on Sable Iſland bank—ſeveral ſmall land birds alighted on the rigging, ſome of which were taken with the hand.
	12	39 36	68 49	70	77		
	4 P. M.			70	77		
	8 A. M.			70	76		
10,	4 P. M.	39 45	69 37	76	76		5th. The water having cooled ſeveral degrees and being at 66°, and having acquired a greeniſh caſt we were undoubtedly in foundings but none were attempted; probably on Sable Iſland bank—ſeveral ſmall land birds alighted on the rigging, ſome of which were taken with the hand.
	8 A. M.			70	75		
	4 P. M.	40 15	70 24	73	66	bright green	
	8 P. M.			67	63		
12,	8 A. M.			67	66		Septem-
	4 P. M.	40 8	70 53	76	68		
13,	8 A. M.			74	68		
	4 P. M.	40 7	71 39	76	68		
14,	8 A. M.			68	67		Septem-
	4 P. M.	40 50	72 57	70	67		
15,	8 A. M.			71	68		
	4 P. M.	40 40	73 23	73	68		
20.		At New York.					

September 6th. The sea becomes again of a bright blue, much gulf weed, and some rock weed, was seen this evening. The same circumstance occurred on the 2d; a westerly breeze raising the eddy of the stream and a N. breeze allaying it.

7th. Becalmed till six A. M. during the calm a strong current setting to the S. or S. S. W. was very perceptible, supposed the eddy of the gulf stream.

8th. The water having changed colour and fallen in temperature to 61° sounded at 10 A. M. and found a bottom at 55 fathom, fine white sand. This bank indicated yesterday about noon by the fall of the thermometer: whatever bank this may be, it does not appear to be in the Charts, we were just 24 hours upon it. At 4 P. M. water 70° and bright blue—no bottom. This day at noon becalmed, the water on the surface was at 78° , but in water taken from a depth of 55 fathom, the thermometer stood at 63° .

11th. At 3 P. M. the water having changed colour, and fallen 9 degrees, indicated an approach to soundings. At 5 P. M. soundings 33 fathom green ooze.

15th. At noon Montuck Point in Long-Island N. N. E. 12 miles. It will appear by the Chart that the reckoning has been well kept; and that what variation occurs, may be supposed to have arisen within the last 7 or 8 days in consequence of currents and calms.

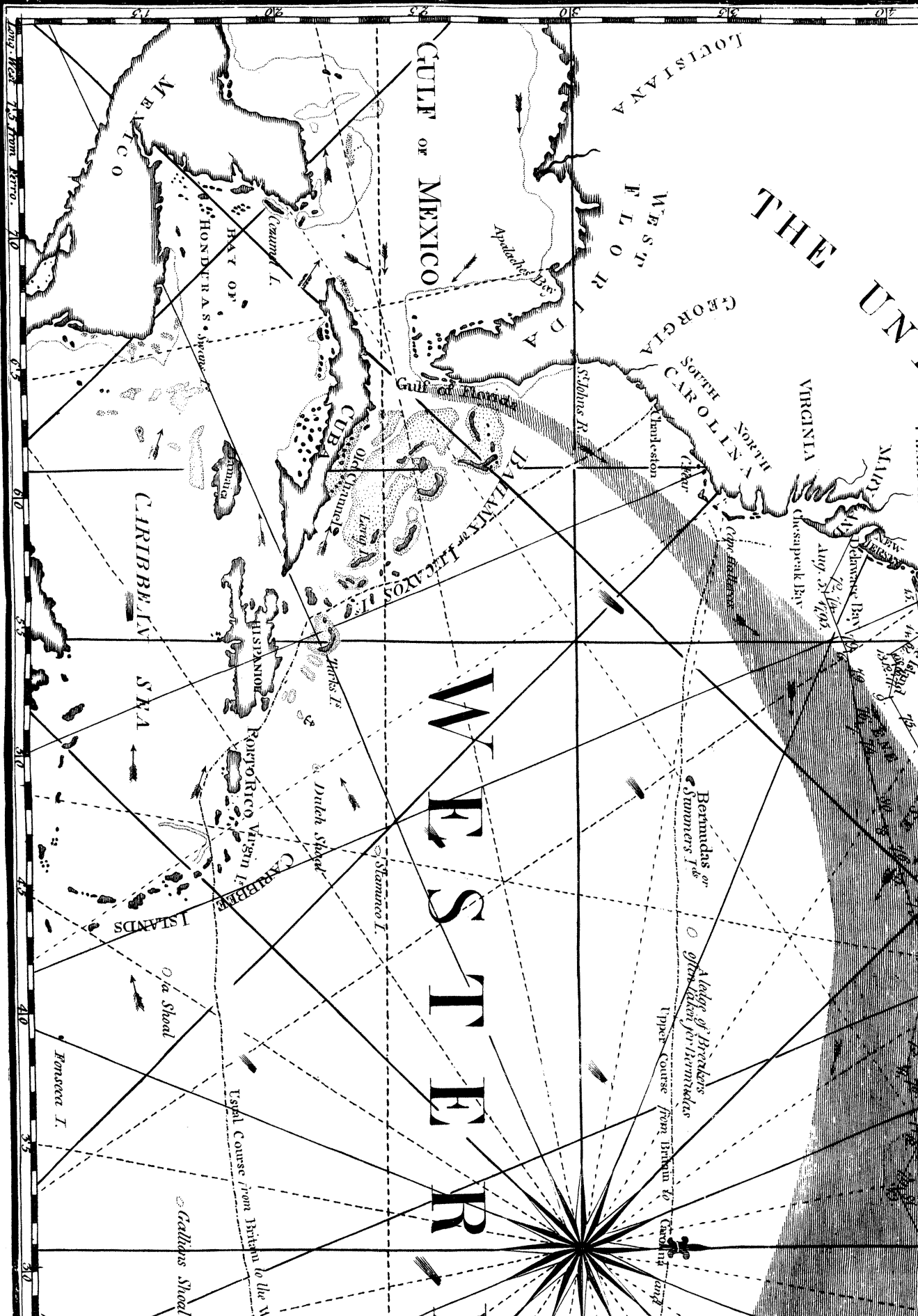
Thermometrical

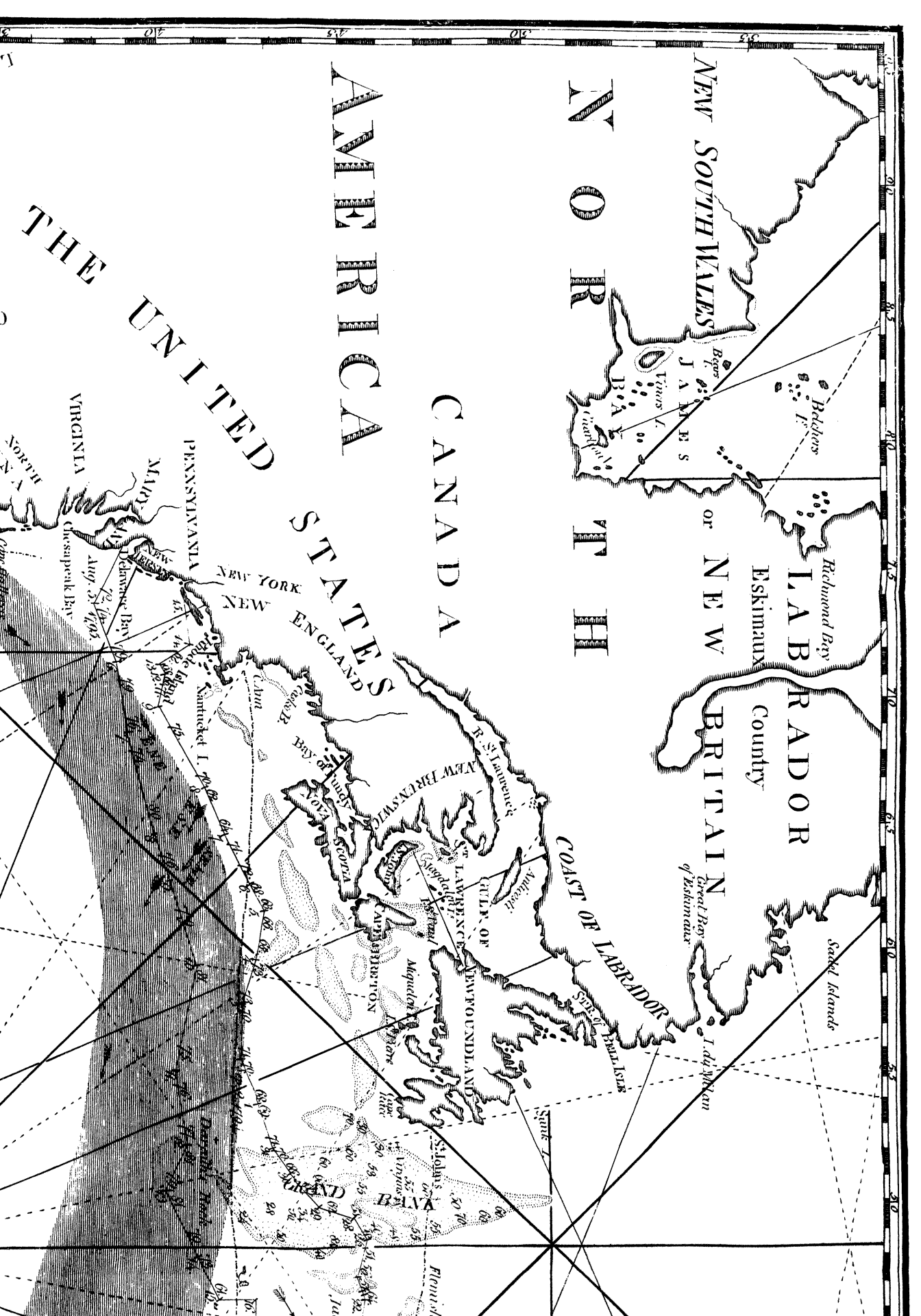
THERMOMETER IN NAVIGATION.

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Thermometrical Journal of the Temperature of the Atmosphere, and of the Sea, on a Passage from Philadelphia to Falmouth on Board the Camilla, Captain George Irwin of Philadelphia, in the Year 1795, kept by William Strickland.

Dates. 1795.	Hour of the Day.	Place at Noon		Temperature of		Appearance of Water.	NOTES AND OBSERVATIONS.
		Lat. N.	Long. W.	Air.	Water.		
July, 29,		{ Embarked at Philadelphia.					August 4, about noon failed from Cape Henlopen the water which in the Delaware had been at 80° was now 76 still influenced by the heat of the river.
30,	12	{ Newcastle, S. W. Dist. 7 M.			80°	very muddy	
31,	12	{ Reedy Island close on W.			80	very muddy	
Aug. 1,	12	{ At anchor at Bombay Hook.			80°		5th, the water which this morning was at 72, in the evening is at 74 gaining warmth as we recede from the land.
2,	12	{ Do. at Do.			85		6th, at 8 A. M. in the gulf-stream, temperature of the water 79°.
3,	12	{ Do. at the Upper Midlings.			84		14th, in the afternoon the water cooled to 73° and 70° and changed to a deep green as if in foundings—we were quitting the gulf-stream.
4,	12	{ Light House at Cape Henlopen, dist. S. W. 3 mi.			85	{ light green but muddy	15th, temperature 61°.
5,	6 A. M.					bright green blue	18th, 63°; the sea for the last four days has shown strong marks of our being in foundings; in the chart are marked two rocks near which we probably were on the 15th at noon. Do banks run out from these? or is the great fall in the water no less than 18 degrees to be attributed to the vicinity of the banks of Newfoundland?—the great decrease in the water on the 16th, 17th and 18th, may in part have been caused
	8 A. M.				76		
	10 A. M.						
	3 P. M.	38° 1'	73° 25'		73		
	8 P. M.				73		
	8 A. M.				74		
6,	3 P. M.	38 3	71 4		75	deep blue	
	8 A. M.				76		
7,					81		
					77	deep blue	





NEW SOUTH WALES

N O R T H

or NEW BRITAIN

LABRADOR
Esquimaux
Country

Richmond Bay

Sackville Islands

Iceland
Great Bay
of Esquimaux

COAST OF LABRADOR

CANADA

AMERICA
STATES

NEW YORK
NEW ENGLAND

PENNSYLVANIA

MARYLAND

VIRGINIA

Chesapeake Bay

NEW BRUNSWICK

R. St. Lawrence

St. Lawrence
Gulf of St. Lawrence

Bay of Fundy

Antigonish

St. John's

St. John's

St. John's

St. John's

St. John's

St. John's

St. John's

St. John's

R I N O C C E A N

OR

• IZORES or the EASTERN ISLANDS

Sancti Spiritus or
Catharina and Virginia

on Britain to the West Indies Carolina and Virginia for sake of the Trade Winds.

Machicom

Breakers

CAPE VERD I.

CAPE VERD

SENEGAL

SPINEGAMBIA

AZANHAGA

the Sargassum

the Salvages

the 8 Stanzas
Double's Shoal

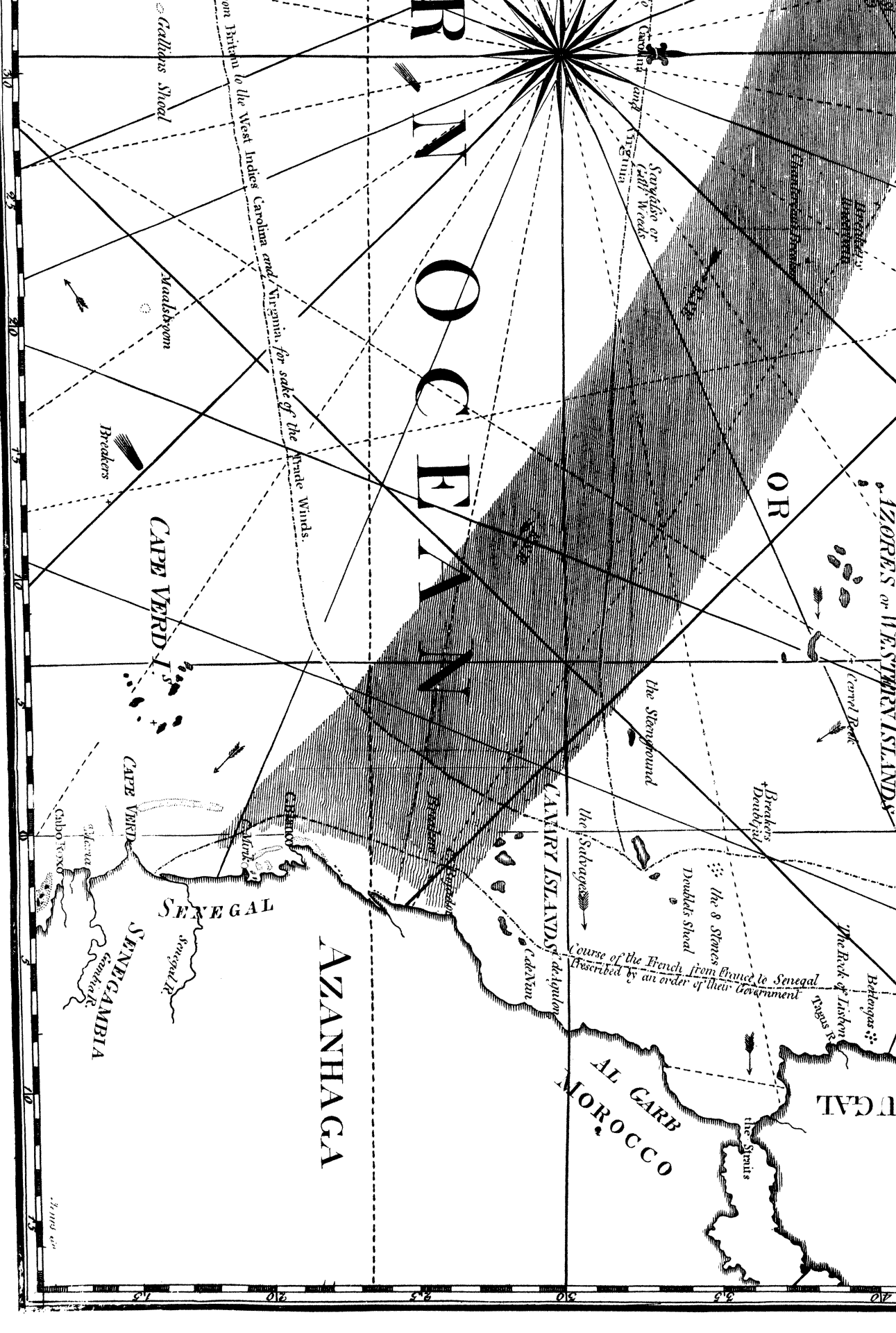
Course of the French from Senegal to Senegal
Prescribed by an order of their Government

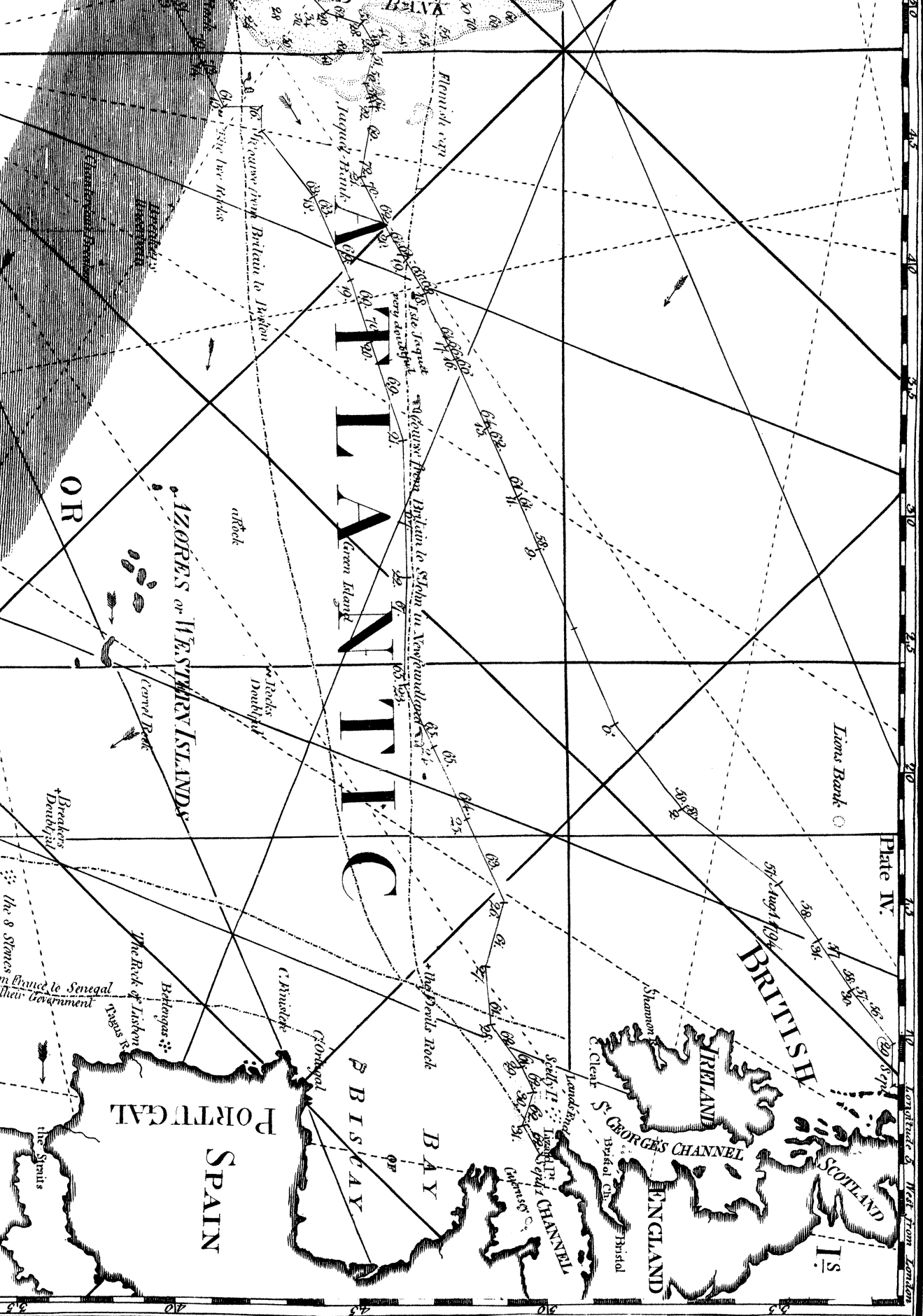
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MOROCCO

TAQA

the Strait

the Strait





Dates. 1795.	Hour of the Day.	Place at Noon.		Temperature of		Appearance of Water.	NOTES AND OBSERVATIONS.
		Lat. N.	Long. W.	Air.	Water.		
Aug. 21,	8 A. M.	46° 21'	32° 34'	71°	69°		felves to be in a branch of the gulf-stream, and in this we continued for two days, when on the 21st it cooled to 67, and thence continued gradually and uniformly to lose warmth in consequence of our northing till we found it at 61 in the chops of the channel.
	3 P. M.			71	67		
23,	8 A. M.			68	65		
	3 P. M.			65	65		
24,	8 A. M.	46 41	23 38	65	64		
	3 P. M.			65	65		
25,	8 A. M.	47 9	21 22	69	65		
	12			65	64		
	3 P. M.	48 3	18 27	63	63	dark green	
26,	8 A. M.	48 48	14 57	61	63	deep blue	
	3 P. M.			63	61		
28,	8 A. M.	48 37	10 2	64	61	muddled green	
	3 P. M.			67	62		
30,	8 A. M.			67	62		
31,	8 A. M.			67	63		
	3 P. M.			68	62		
Sept. 1,	8 A. M.			67	62		

In soundings.
 { Landfend N. 12
 } miles.